Five-Year Creel Survey of Two Florida Lakes

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Lakes Griffin and Harris, with surface acreages of 9,100 and 16,500 respectively, were the study areas selected for this project. Located in central Florida near the city of Leesburg, these natural lakes provide a popular recreation area for this section of the State. Historically, Griffin and Harris enjoyed excellent reputations for their sport fisheries, but in recent years considerable local criticism has developed concerning fisheries quality, especially in Lake Griffin. Both lakes are showing signs of environmental degradation from cultural eutrophication and can be considered eutrophic. Present conditions are characterized by turbid waters supporting dense blue-green algal populations, extensive bottom muds, and large carrying capacities for fishes. Of the two lakes, Griffin is considered more advanced in its eutrophic state.

During 1966 a creel survey of the present design was implemented to document existing fisheries and monitor changes or trends through time. The survey provided for seasonal and annual estimates of fishing pressure, catch composition, and fishing success. Results have been compiled and analyzed for the past five years. The purpose of this paper is to present these findings, documenting the fisheries quality of two Florida lakes and discuss aspects of the creel design.

Creel Method

The Griffin and Harris creel program evolved from a randomized systematic creel census that was employed by our agency during the early Sixties. By 1964, certain limitations were realized and a more efficient program sought. Dr. Don W. Hayne, Institute of Statistics, North Carolina State University, was contacted for consultation, and, working with Mr. James P. Clugston of the Commission, he designed the stratified creel survey with non-uniform probability sampling currently in use. The design was computerized by the Cooperative Statistical Unit and now serves as a model for creel surveys in other Southeastern States.

Stratification of the roving creel survey involves the designation

of areas within lakes, periods of time, and kinds of days (weekday or weekend day). Within each time stratum samples are selected randomly and with non-uniform probabilities, which are proportional to the predicted daily patterns of fishing activity (determined by prior study). Both stratification and unequal probabilities are imposed to reduce the variance of estimates below those which would occur if simple random sampling were used. In a practical sense the area stratification facilitates implementation of the survey over large areas of the lake and allows for separate area estimates. Sampling in time, with non-uniform probability based on fishing activity, ensures that most of the creel clerk's effort will coincide with most of the fishing activity. The basic value of the non-uniform probability sampling scheme is discussed by Pfeiffer (1966).

Creel sampling schedule was set up on a basis of two-week periods the year around. Within each period five days were scheduled for sampling each lake by random selection and included at least one weekend day. This allowed for 10 work-days and four off-days per sample period. Each sample day was also divided into two periods; 7:00 AM-1:00 PM and 1:00 PM-7:00 PM in order to include the entire day. The non-uniform probabilities were then assigned to each sample period within a day and according to the type of day (weekend or weekday). Because of their large size, Lakes Griffin and Harris were separated into six approximately equal areas (Figs. 6 and 7). This facilitated the collection of data by requiring the clerk to spend one hour in each area and provided for separate area estimates (not presented here).

Creel data were transferred to I.B.M. cards and shipped to North Carolina State University, where estimates were calculated on the I.B.M. 360 System Computer, Model 75. Dr. Robert E. Mason, Assistant Statistician, North Carolina State University, was responsible for computer processing. He also served as primary consultant concerning the mechanics of the design.

One characteristic of our creel survey, often not found in others, is the measurement of fishing success by species effort. It is believed that such information provides a more accurate estimate of the fishery quality for a species. In practice, only those fishermen determined (by interview) to be fishing for a particular fish were used in the estimate calculation of success for that species. This accomplishes a measurement of the catch rate of bass, for example,

TABLE 1
Estimate precision for lakes Griffin and Harris creel survey

Year and Lake	Criteria	Estimate	Approximate SD	Per Cent SD of the Mean
1966–1967				
Lake Griffin	Total Pressure	255,090	26,529	10.4
Lake Griffin	Total Catch	238,620	65,620	27.5
Lake Harris	Total Pressure	230,838	24,469	10.6
Lake Harris	Total Catch	202,710	48,042	23.7
1967–1968				
Lake Griffin	Total Pressure	240,246	32,546	13.5
Lake Griffin	Total Catch	219,018	40,028	18.3
Lake Harris	Total Pressure	175,944	16,715	9.5
Lake Harris	Total Catch	125,994	30,994	24.6
1968–1969				
Lake Griffin	Total Pressure	327,066	50,041	15.3
Lake Griffin	Total Catch	300,942	61,091	20.3
Lake Harris	Total Pressure	180,444	23,870	13.2
Lake Harris	Total Catch	166,248	48,361	29.1
1969–1970				
Lake Griffin	Total Pressure	265,890	54,175	20.4
Lake Griffin	Total Catch	270,744	88,330	32.6
Lake Harris	Total Pressure	199,238	24,646	12.4
Lake Harris	Total Catch	180,600	38,480	21.3
1970–1971				
Lake Griffin	Total Pressure	230,498	27,579	12.0
Lake Griffin	Total Catch	222,892	75,494	33.9
Lake Harris	Total Pressure	244,720	25,293	10.3
Lake Harris	Total Catch	330,574	88,255	26.7

by bass fishermen and excludes other incidental catches of bass. However, there are periods when estimates cannot be made by the computer program in this manner. This occurs when there are no records of fishing for a particular species or when catches are incidental to fishing for other fishes. Mr. D. E. Holcomb of the Commission implemented this modification in creel design during the 1967 creel year.

Computer output for our program provides estimates of fishing pressure, both total and species-directed pressure in man-hours, total numerical catch by species, and fishing success (number of

fish per man-hour of effort). Two important limitations of the data are recognized; there is no estimation for weight of fish harvested or of man-day use. Both of these criteria could be answered by additional sampling, but this was not done in this study.

Another useful element of the computer output is the value of "approximate standard deviation" (usually called standard error) that is provided for each summary estimate. This gives an approximate plus or minus value as an estimate of precision. It should be understood however, that an exact confidence interval cannot be computed for these figures because the underlying distribution of the estimates is not normally distributed (Dr. Don W. Hayne, personal communication). Examples of the precision of estimates obtained in this study are provided in Table 1.

FINDINGS

The principal fishes sought-after by sport fishermen at lakes Griffin and Harris were largemouth bass (*Micropterus salmoides*),

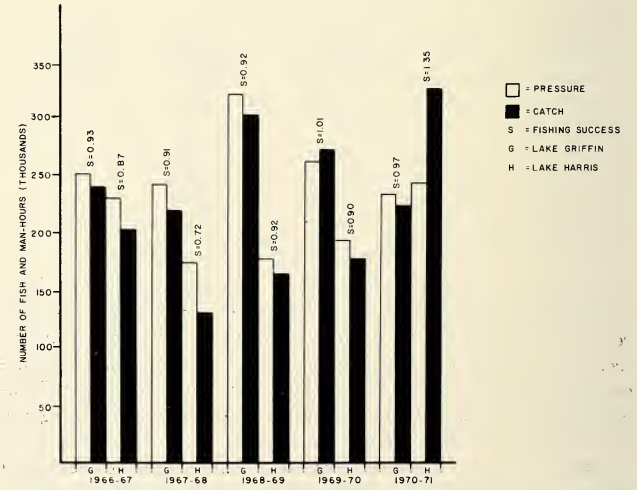

Fig. 1. Estimated fishing pressure, catch, and fishing success for lakes Griffin and Harris, 1966-1971.

black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), and redear sunfish (*Lepomis microlophus*). For the purpose of collecting creel data bluegill and redear were recorded in aggregate and categorized as "bream". Catfish species were also reported as a composite since they constituted a relatively minor portion of the fisheries. Species of Ictaluridae included channel catfish, (*Ictalurus punctatus*), white catfish (*I. catus*), brown bullhead (*I. nebulosus*), and yellow bullhead (*I. natalis*).

Fishing Pressure and Catch. Annual estimates of fishing pressure, catch, and success for the five year period (1966-71) on Lakes Griffin and Harris are shown in Fig. 1. In general, the data show a positive correlation between fishing pressure and catch, as pressure was increased the catch also increased.

Fishing pressure was higher on Lake Griffin for all years except 1970-71. Range in annual pressure was from an estimated low of 230,498 man-hours in 1970-71 to a high of 327,066 man-hours during 1968-69 (Fig. 1). Calculations of fishing pressure on a per acre basis varied from 25.3 man-hours per year to 34.9 man-hours per year.

Annual catch from Griffin was correspondingly higher for all years but 1970-71. Catch varied from an estimated low of 219,018 fishes in 1967-68 to a high of 300,942 fishes in 1968-69 (Fig. 1). Annual harvest per acre ranged from 24.5 to 33.2 fishes.

Fishing pressure and catch for Lake Harris, the larger lake, ranged from an estimated low in 1967-68 of 175,944 man-hours of fishing and a catch of 125,994 fishes, to a high in 1970-71 of 244,720 man-hours fishing and a catch of 330,574 fishes; the highest yield for either lake during the study period (Fig. 1). Calculated on a per acre basis, exploitation of the fishery resource by sport fishing was relatively minor in Harris, ranging from 7.6-20 fishes per year. Fishing pressure per acre varied from 10.7-14.8 man-hours per year.

Lake Griffin Catch Composition and Fishing Pressure by Species. The data in Fig. 2 illustrate fishing pressure directed at each species and estimated composition of the catch over the five year period. These data show that the sport fishery of Lake Griffin was sustained largely by panfishes.

Black crappie was the most sought-after species by sport fishermen, sustaining 42.7 per cent of the estimated total pressure over a four year period (species fishing pressure was not determined dur-

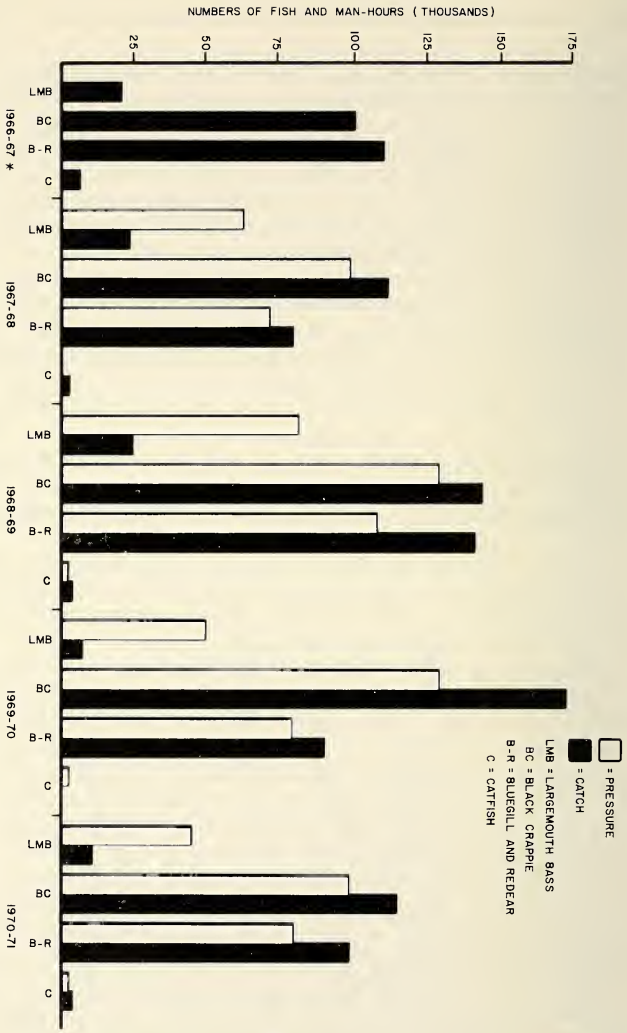

Fig. 2. Estimated fishing pressure by species and catch composition of Lake Griffin, 1966-1971. *Pressure by species not available.

ing the first creel year 1966-67). Annual estimates of pressure for crappie varied from 98,778-130,374 man-hours (Fig. 2). Similarly, crappie accounted for over one-half the estimated total catch (51.2 per cent) for the creel period. The highest annual yield of this species was 173,112 fishes during 1970-71 (19 fish/acre), and crappie composed 63.9 per cent of the total catch for that year. According to our creel clerk the estimated average size black crappie taken from Griffin is 12 ounces.

Bluegill and redear, categorized as "bream", ranked second in fishermen's choice at Lake Griffin, based on man-hours of effort expended by fishermen. The four year summary indicated 32.4 per cent of the total pressure was for these species. Annual fishing pressure estimates for "bream" ranged from 72,192-110,742 man-hours, while annual catches varied from 88,644-137,358 fishes (Fig. 2). "Bream" comprised 41 per cent of the total catch for the five year period. Average weight of these species in Griffin is reported at 8 ounces.

Almost one-fourth of the total fishing pressure (23 per cent) was directed toward largemouth bass. Yet, this species provided only 6.4 per cent of the total catch during the period of study. Available evidence suggests the fishery is declining. In the first three creel years, the catch of largemouth bass varied between an estimated 19,434-23,772 fish and composed between 7.9 per cent and 9.4 per cent of the total catch, whereas in the last two years, the catch dropped to 7,374 fish and 9,371 fish, a composition of 2.7 per cent and 4.2 per cent of the total catch respectively (Fig. 2). Fishing pressure for bass also declined from a high of 82,380 man-hours in 1968-69 to a low of 47,684 man-hours in 1970-71. However, the pressure drop was not proportional to the decrease in catch (Fig. 2). Observations indicated the average creel-size bass was approximately 2 pounds.

Catfish comprised a minor portion of the Griffin sport fishery. Total fishing pressure for these species amounts to less than one per cent for any creel year. Highest annual catch was estimated at 5,994 fish, a composition of 2.5 per cent (Fig. 2).

Lake Harris Catch Composition and Fishing Pressure by Species. Fig. 3 shows the estimated fishing pressure for each species and catch composition for Lake Harris during the five year study. Several differences appear when comparing the Harris fishery with

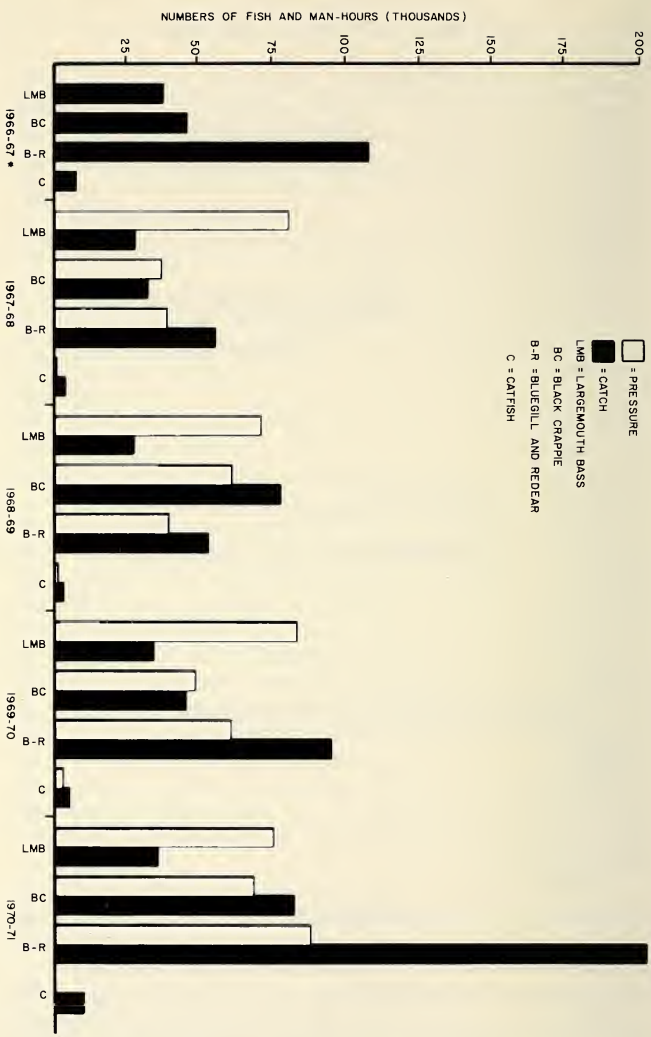

Fig. 3. Estimated fishing pressure by species and catch composition of Lake Harris, 1966-1971. *Pressure by species not available.

Lake Griffin. Probably most significant is the better distribution of the catch or "balance in fisheries quality" for Lake Harris.

Largemouth bass was the number one species fished for by sport fishermen at Lake Harris. Of the total fishing pressure that was estimable at the species level (4 years), 38.9 per cent was directed at largemouth bass. Annual fishing pressure for bass was relatively stable, fluctuating between 72,414-83,058 man-hours (Fig. 3). Only during one creel year, 1970-71, did other species ("bream") outrank bass in fishing pressure. Estimated annual catches of bass varied between 27,246-39,084 fish (Fig. 3). Annual yields fluctuated between 1.6-2.3 bass per surface acre. Bass composition of the catch for the five year creel was 16.4 per cent. Their highest catch composition was 23.5 per cent during 1967-68. The reported average creel-size largemouth bass from Harris was 1 pound 8 ounces.

Bluegill and redear ranked second in fishing pressure by a narrow margin over black crappie. The "bream" fishery comprised 28.7 per cent of the estimated total fishing pressure. Annual fishing pressure for these species varied between 38,850-88,387 man-hours (Fig. 3). During 1970-71 they were the most popular species sought by fishermen. "Bream" dominated the catch of the Harris fishery, comprising 51.9 per cent of the total harvest for the five year period. Annual estimated catches of "bream" ranged from 56,322-201,943 fishes (Fig. 3). Highest annual yield per acre was 12.2 fish in 1970-71. Average size of these species taken in the Harris creel was estimated at 6 ounces.

Black crappie attracted 27.9 per cent of the total pressure and provided 28.8 per cent of the estimated catch in Harris during the study. Annual estimates of pressure varied between 40,422-71,996 man-hours, while annual catches ranged from 34,734-83,628 fish (Fig. 3). Maximum estimated annual yield was 5 crappie per acre. The average creel-size black crappie for Harris was reported at 8 ounces.

Catfish in Lake Harris, as in Griffin, were a relatively minor component of the fishery. The highest annual catch was 10,563 fishes, a composition of 3.2 per cent, and pressure attracted by these species amounted to less than one per cent for any given year (Fig. 3).

Seasonal Distribution of Catches. Seasonal trends in the fish-

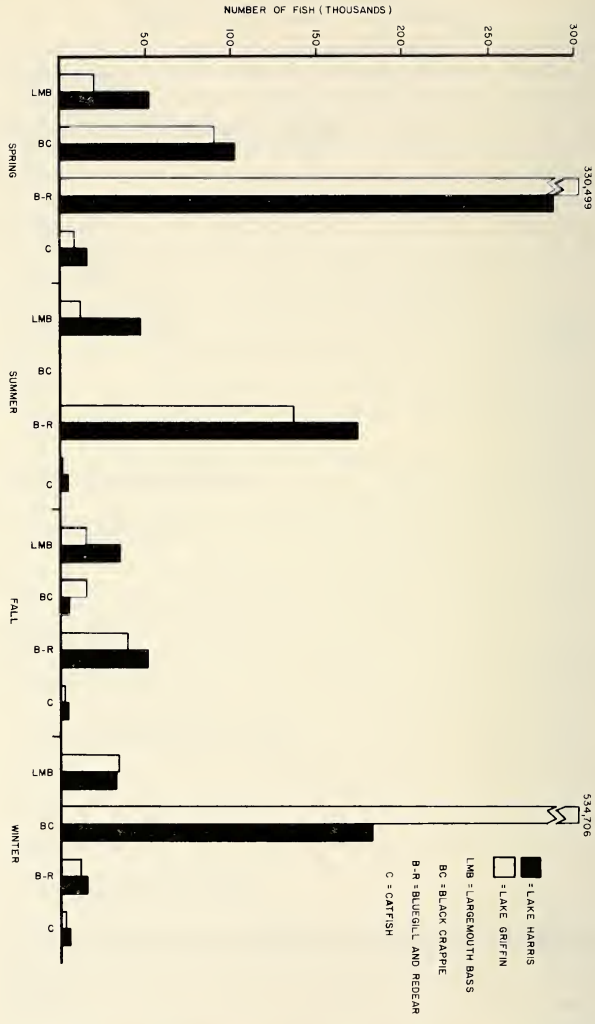

Fig. 4. Estimated seasonal distribution of catch for lakes Griffin and Harris, 1966-1971.

eries for certain species were strongly evident and followed similar patterns in both lakes. Depending on species, a high proportion of the catch was generally made during one or two seasons of the year. Fig. 4 shows seasonal harvest by species for lakes Griffin and Harris over the five year creel period. Trends depicted for these lakes are generally representative for most waters in South Florida (authors observations).

Distribution of seasonal catch was most restricted with black crappie. The principal harvest occurred during winter in both lakes (Fig. 4). Substantial catches were also evident during early spring, but dropped rapidly after mid-April. The harvest of crappie was relatively insignificant during summer and fall seasons.

Bluegill and redear were also seasonal in the fisheries they provided. Highest yields were taken during spring, although summer provided a significant portion of the harvest (Fig. 4). Relatively few "bream" were caught during winter.

Largemouth bass showed very minor seasonal differences in catch (Fig. 4). In Lake Griffin, bass were caught in greatest numbers during winter, in the next greatest numbers during spring. Lowest bass yield was during summer. The largest proportion of the Lake Harris bass catch was during spring and summer, but seasonal differences were small for any given period in this lake (Fig. 4).

Fishing Success. In this study success is determined by the catch rate of numbers of fish for the man-hours of fishing effort. The data are presented in two forms for Lakes Griffin and Harris, general fishing success determined by total fish caught divided by total fishing pressure for a given unit of time (Fig. 1), and fishing success for each species as determined from data obtained from fishermen fishing for a particular species (most fishermen fished for a certain species in this study). Fig. 5 presents fishing success by species for Lakes Griffin and Harris from 1967-1971. Calculations of species success could not be made for creel year 1966-67 because of limitations previously mentioned in creel design.

Overall fishing success for Lake Griffin was relatively stable for the study period. Annual success estimates ranged from 0.91-1.01 fish per man-hour (Fig. 1). The stability exhibited by the Griffin fishery has been largely related to the consistently good fishing afforded by panfishes (Fig. 5).

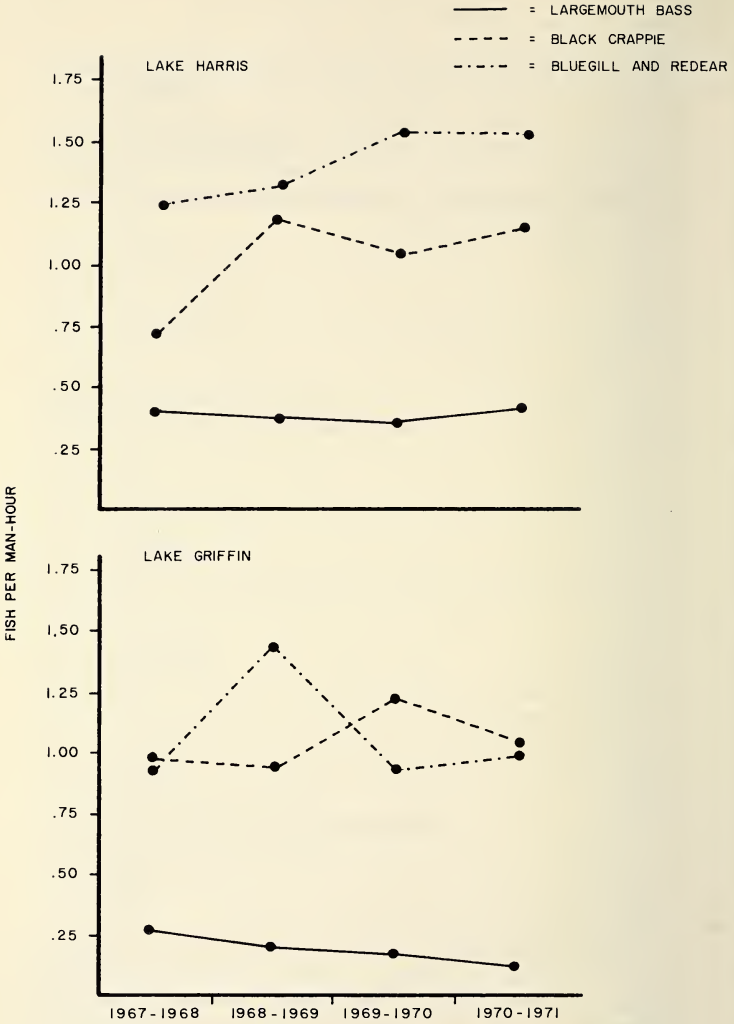

Fig. 5. Fishing success by species effort for lakes Griffin and Harris, 1967-1971.

Fishing success for largemouth bass at Griffin has shown a gradual but steady decline. Our earliest estimate in 1967-68 found an average catch rate of 0.26 bass per man-hour. By 1970-71 success had dropped to an average of 0.14 bass per man-hour (Fig. 5). The decline in bass fishing success is believed to be related to the lake's accelerated eutrophication or rate of degradation. Considerable evidence has been collected in Florida showing largemouth bass to be one of the first species to disappear from a fishery as lakes enter into advanced stages of eutrophication (Fla. Game and Fish Memo Reports, unpublished).

Black crappie have exhibited a relatively stable catch rate in Lake Griffin. Extremes in the estimates of average success have ranged from a low of 0.93 crappie per man-hour in 1968-69 to a high average of 1.22 crappie per man-hour for 1969-70 (Fig. 5). The stabilized nature of the crappie fishery was somewhat unexpected since the species is reputed to be cyclic in its fishery quality.

Lake Griffin bluegill and redear showed the greatest fluctuation in fishing success. The lowest catch rate recorded was in 1967-68, average success of 0.91 "bream" per man-hour, whereas best fishing occurred the following year, an average catch rate of 1.43 "bream" per man-hour (Fig. 5). One interesting aspect of these data is the apparent lack of deterioration in fisheries quality for panfish at a time when lake habitat conditions are known to be degrading (Wilbur, 1969).

Sport fishing quality in Lake Harris showed considerable shifting during the period of study, possibly reflecting better ecosystem dynamics than Griffin. Studies have indicated better habitat conditions and fish population structures associated with Harris (Fla. Game and Fish Memo Reports, unpublished). General fishing success on an annual basis varied between a low of 0.72 fish per man-hour and a high of 1.35 fish per man-hour. During the last three years the catch rate has been maintained at 0.90 fish per man-hour or above (Fig. 1).

Good fishing for largemouth bass, the most sought-after species on Harris, was indicated during the period of record. Success fluctuated very little, ranging between 0.34 bass per man-hour and 0.40 bass per man-hour annually (Fig. 5). Although not as high as reported from some Florida waters (R. L. Wilbur, personal communication), the Harris average catch rate of one bass for less than three

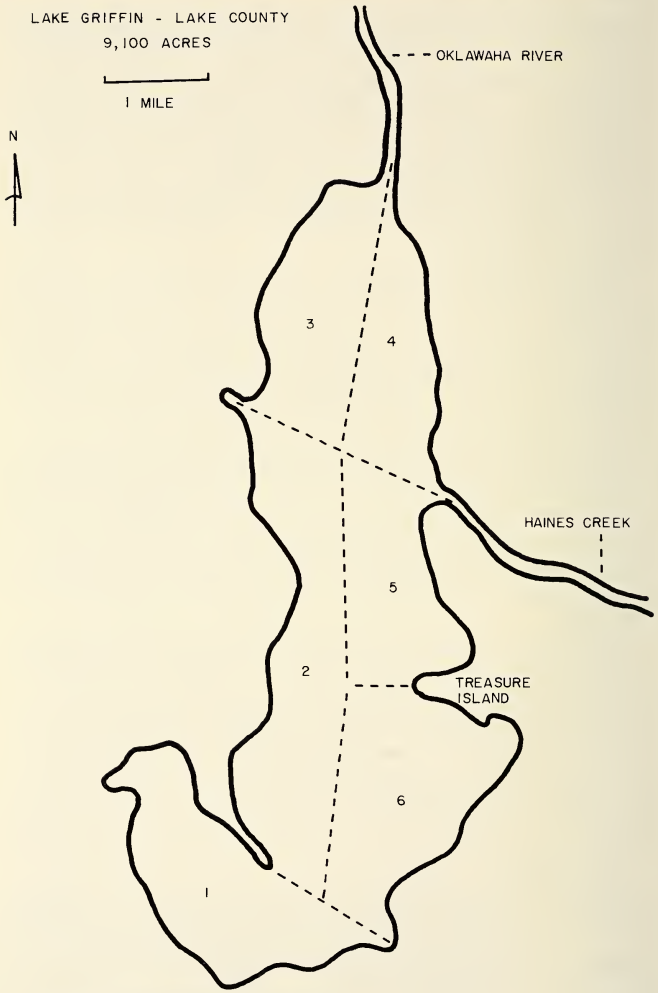

Fig. 6. Creel areas for Lake Griffin.

hours effort compares favorably with national estimates reported by Lagler (1956).

Black crappie maintained a catch rate above one fish per man-hour during three of the four years of record on Harris. During 1967-68 the estimated fishing success was a low 0.70 crappie per man-hour, whereas in the years following fishing success ranged between 1.03-1.17 crappie per man-hour (Fig. 5).

The Lake Harris "bream" fishery provided the highest fishing success of the creel survey. Annual average catch rates were estimated between 1.24-1.55 "bream" per man-hour (Fig. 5).

Discussion and Summary

Although lakes Griffin and Harris are located within the same watershed and adjacent to the same populous area, the creel survey has shown their fisheries to be of distinctly separate qualities. Sport fishing on Lake Griffin has been largely supported by panfishes; black crappie during the winter months, and bluegill and redear in the late spring and summer. The fishery for largemouth bass has declined steadily since the study began. Bass fishing is now considered to be relatively poor. Fishing pressure and yields per acre were higher on Lake Griffin.

Conversely, the Lake Harris fishery has shown a better catch distribution among available game fishes. Largemouth bass were chiefly responsible for the difference, providing a substantial portion of the annual yield for each creel year. Bass also attracted a major segment of the fishing pressure, which was probably related to the relatively good catch rate. The fishery for panfish showed a trend of general improvement during the study period. Bluegill and redear comprised the greatest portion of the catch, although black crappie yields were of significant importance, especially during winter months.

Fishing success of Lakes Griffin and Harris compared favorably with other waters in the southeast. Davis and Hughes (1963) presented a summary of fishing success for 10 southern reservoirs showing catch rates varying from 0.50-1.96 fish per man-hour. Half of these reservoirs maintained a success rate below 0.90 fish per man-hour, which was the approximate mode for Griffin and Harris. A recent study conducted on Beaver Reservoir, a relatively new im-

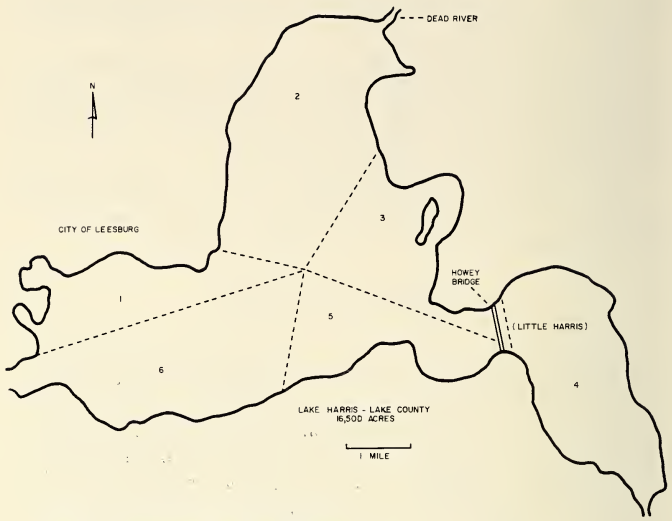

Fig. 7. Creel areas for Lake Harris.

poundment in Arkansas, found an average catch rate of 0.62 fish per man-hour (David Morais, personal communication). Jarman et al. (1967), reporting on 12 state owned lakes in Oklahoma, found catch rates ranging from 0.1-0.6 fish per man-hour. Reported fishing success from a popular western reservoir, Lake Meade, was shown to range from 0.30-0.81 fish per man-hour during a 10 year period (Espinosa and Deacon, 1971).

Intensity of fishing pressure and yields from our Florida lakes were generally lower, when compared to other southeastern lakes. Byrd and Crance (1965) found average annual yields of 573 fishes weighing 173 pounds per acre from 20 state owned lakes in Alabama. They did not provide fishing pressure data in man-hours, but as fisherman-trips, which averaged 135 per acre annually. Fishing pressure on Oklahoma's state owned lakes varied between 138-622 man-hours per acre, whereas yields ranged from 68-242 fishes per acre (Jarman et al., 1967). In a study of Bull Shoals Reservoir, Burress (1962) reported fishing pressure as high as 113.9 man-hours

per acre and yields varying between 44-76 fish per acre. The highest annual yield from lakes Griffin and Harris was 33.2 fishes per acre (Griffin) while the heaviest annual fishing pressure was 34.9 man-hours per acre (Griffin). These data indicate the sport fisheries of Florida lakes could withstand considerably more fishermen utilization.

Creel census design used in this study proved suitable to our needs. Man-power required for the water area involved and compilation of data was felt to be reasonable. The creel clerk's job was full time (260 man-days a year), while preparation of data for computer processing approximated 12 man-days a year. Activities of the project leader required only routine supervision of personnel and review of field data and computer output.

Creel estimates provided by the program, as shown in Table 1, were considered to be within acceptable limits. Percent standard deviation of the estimate mean was below 25 per cent for three-fourths of the estimates. The highest per centage was 33.9 per cent (Table 1). For investigators desiring greater estimate precision intensification of sampling effort would be indicated.

Acknowledgments

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